Space Weather Technical Forecast

Issued on Wednesday, 02 November 2022 at 01:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Storms 03, 04 and 05 November. Chance of Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low or very low over the last 24 hours, with only minor low energy C-class flares observed. There are currently five numbered sunspot regions on the visible disc. AR3131 (Hhx/Alpha) and AR3135 (Eso/Beta) are the most mature and largest regions, although appear inactive. AR3136 (Cro/Beta) has recently developed in the southeast quadrant, with some complexity, which will continued to be monitored. Newly numbered sunspot regions AR3137 (Axx/Alpha) in the northeast and AR3138 (Axx/Alpha) in the southeast, are both small and simple regions. A filament eruption was observed in the northwest quadrant around 01/1600 UTC, which produced a Coronal Mass Ejection (CME), which is currently being analysed for any potential Earth-directed component. No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, observed by DSCOVR at L1, has followed a slightly declining trend from 490km/s to around 420km/s. This is indicative of the waning fast wind of coronal hole 37. Density was average to below average. Total interplanetary magnetic field strength was weak at 5nT throughout. The north-south component, Bz, also varied weakly. Phi angle was predominantly positive (away from the Sun). Geomagnetic activity was mainly Quiet to Unsettled (Kp 2-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2MeV) at GOES-16 was at moderate levels, but increased above the high threshold from around 01/1130 UTC, with a peak of 1783pfu observed at 01/1655 UTC. Electron fluence levels were below the Active threshold with a peak value of 6.45e7 integrated pfu observed at 02/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low or Very Low, with a very slight, but increasing, chance of isolated Moderate activity.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are forecast. The Earth is currently under the influence of a waning high speed stream from coronal hole 37, with a declining trend. Uncertainty in regards to a possible connection to CH38, although this feature is probably to far north of the solar equator for any impact at Earth. HSS from CH37 will continue to wane into day 1 (2nd Nov) towards background levels. Another connection with the HSS from CH39 is then due late on day 2 (3rd Nov) into day 3 (4th Nov), with speeds likely to be in the range of 500-600km/s, persisting into day 4 (5th Nov). Geomagnetic activity will be mainly Quiet to Unsettled on the 2nd Nov and much of the 3rd November. There is a chance of Active to G1/Minor Storms either late on 3rd Nov or during 4th and 5th November due to the connection

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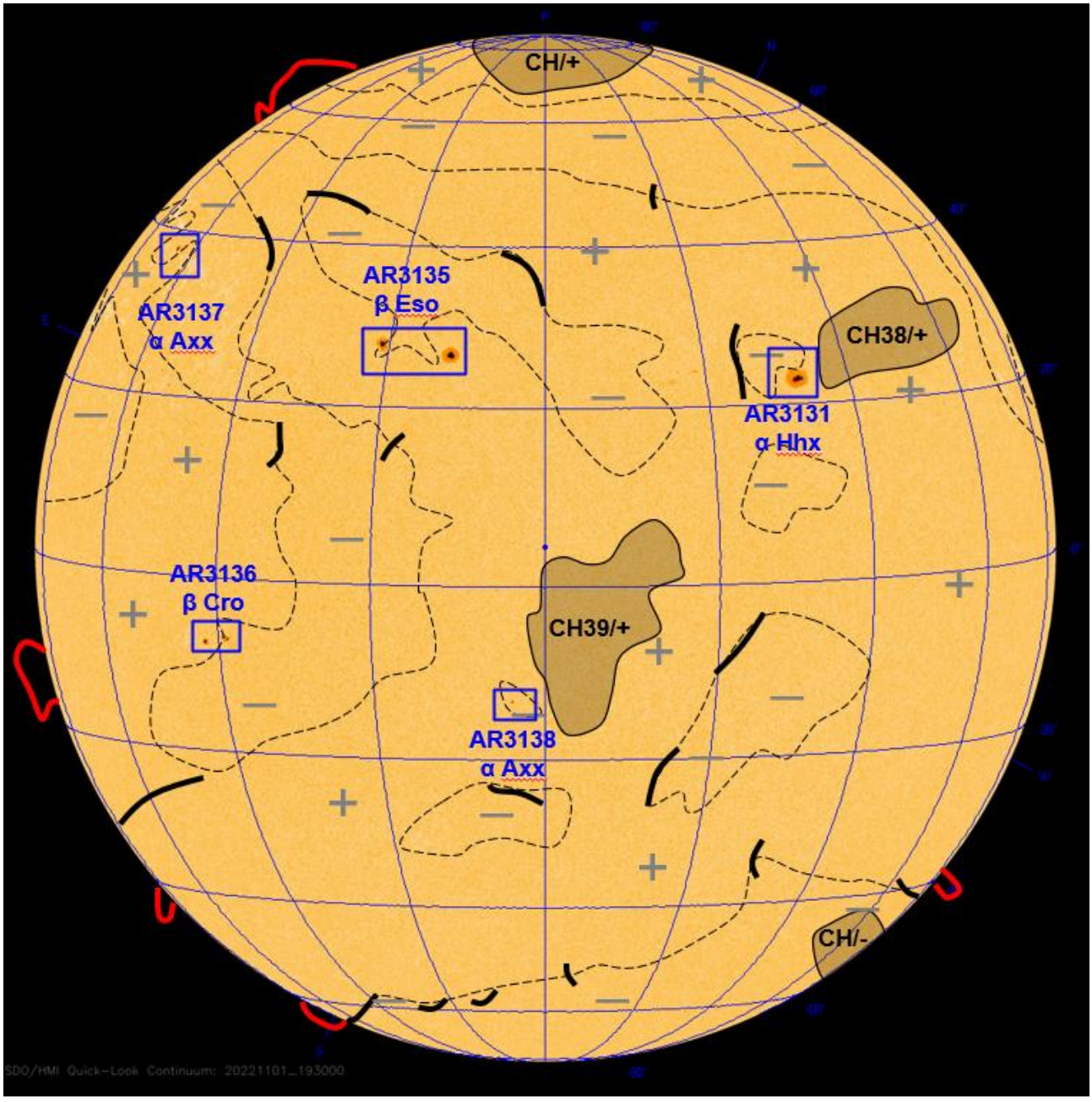
with the HSS from CH39.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) observed by GOES-16 is expected to be at background levels. High energy electron flux (greater than 2MeV) observed by GOES-16 is forecast to be at moderate to high levels. The associated 24 hour electron fluence is expected to continue close to or just above the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 01/1830 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:
No Earth directed CMEs are forecast.

Earth is currently under the waning influence of the high speed stream (HSS) from coronal hole 37 which has now rotated off the visible disc. The HSS from CH38 is now considered unlikely to impact at Earth, as its further north of the solar equator. Solar winds are likely to decline slightly on day 1 (2nd Nov) although are likely to remain slightly elevated. Another HSS from CH39 is due to connect either late on day 2 (3rd Nov) or into day 3 (4th Nov) with speeds of 500-600km/s forecast, and likely to persist into day 4 (5th Nov), based on persistence.

Geomagnetic activity is forecast to be mainly Quiet to Unsettled on day 1 (2nd Nov), then Unsettled to Active days 2 to 4 (3rd to 5th Nov) with a chance of G1/Minor Storms due to the connection with a HSS from CH39.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	20	40	40
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: SDO AIA 211 image shows a large coronal hole (CH39) near centre disc, which will bring a fast wind to Earth 4th and 5th November.

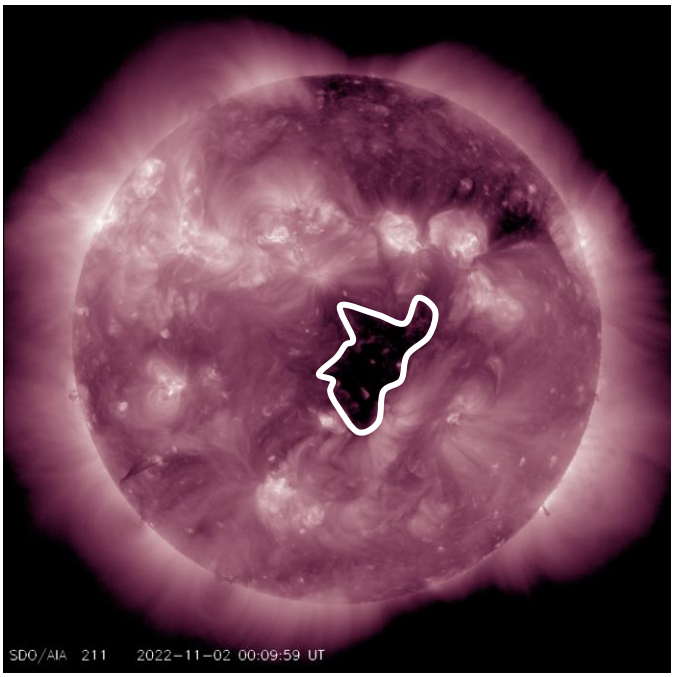

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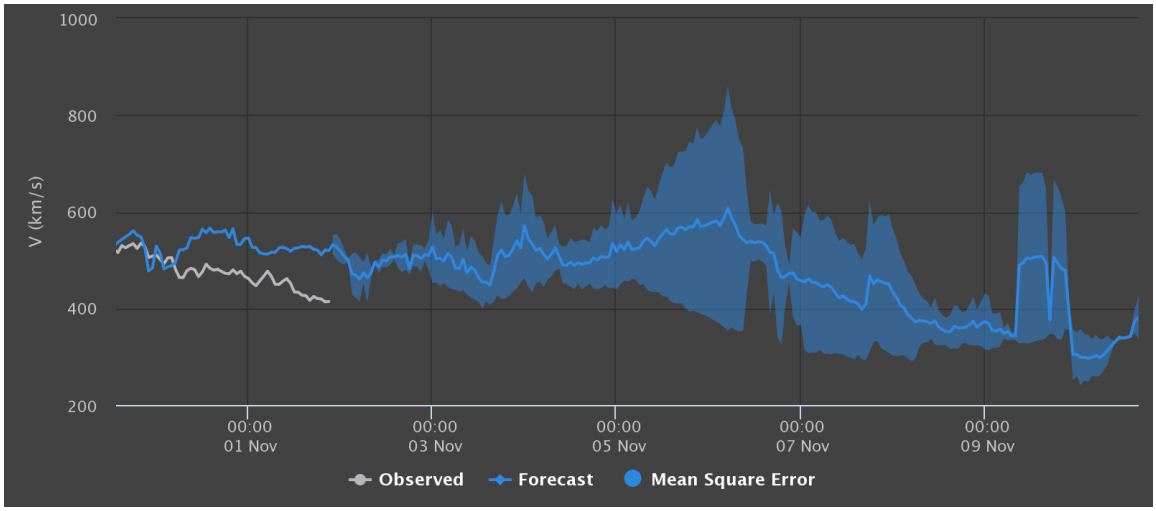
Figure 3: MOSWOC SWPM (bottom) shows increased solar winds on 4th and 5th Nov, due to connection with HSS from CH39



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Radio Blackouts - X-Ray Flares:
There are two significant sunspots on the visible disc, AR3131 in the northwest quadrant and AR3135 in the northeast. Both these are relatively simple but mature regions. AR3136 in the southeast has developed noticeably over the last 24 hours. The remaining regions are all simple and stable or are only developing slowly.

There are a number of bright flux areas due to rotate onto the visible disc through the next four days, with a steadily increasing risk of M-class flaring.

Solar activity is expected to be mainly Low or Very Low with a slight but increasing chance of Moderate activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	20	20	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 4: STEREO-A EUVI 195 image shows bright flux regions close to the east limb – which are due to rotate onto the visible disc in the coming days.

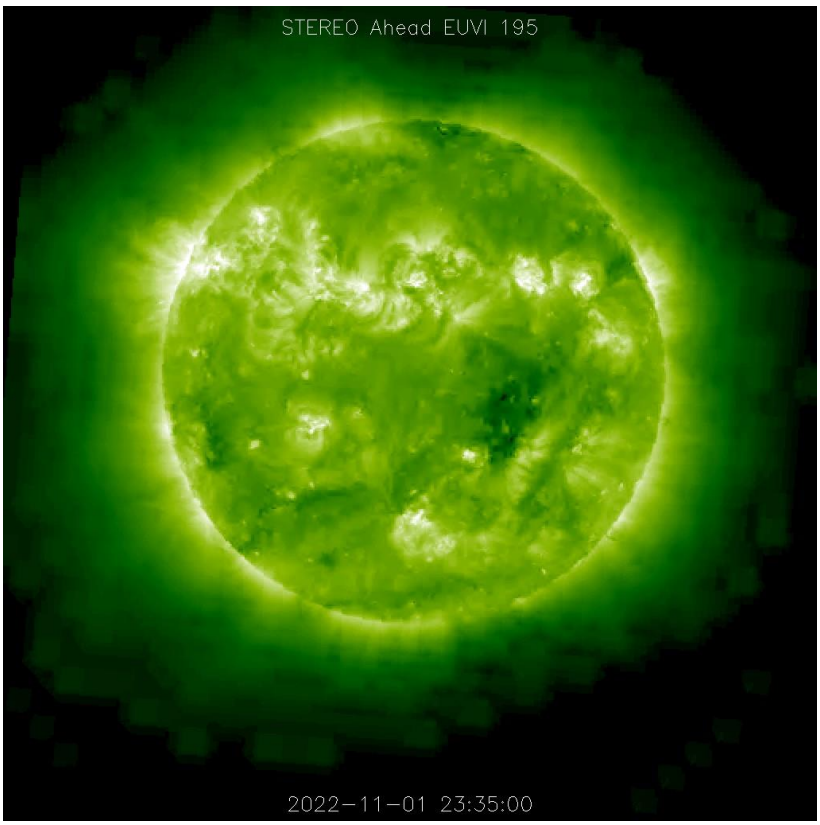

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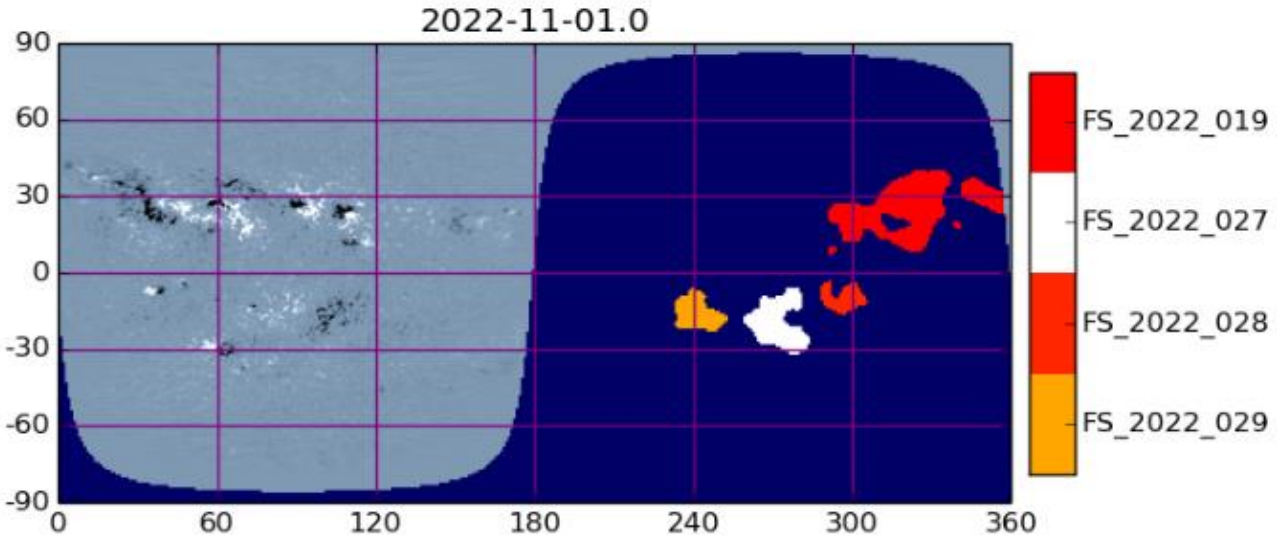
Figure 5: Stanford Seismic Monitor of the Sun's far-side – shows large areas due to rotate around the east limb, probably the source of a recent far-sided CME.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) at GEO, observed by GOES-16 is currently at background and is forecast to remain at this level through the guidance period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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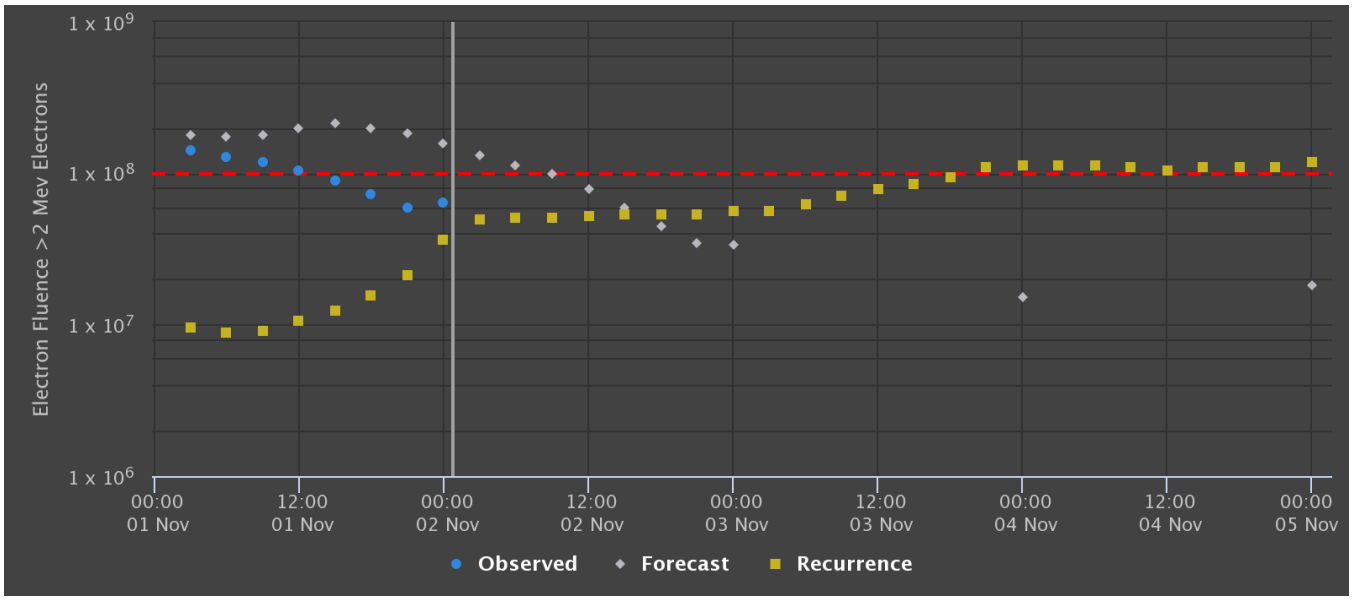
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) is expected to continue at moderate to high levels through much of the period. There is a risk of brief declines due to strong high speed streams deforming the radiation belts away from their natural orbits, but an increase should then be observed as the belts relax.

The electron fluence values are likely to remain close to or rising above the Active threshold (1e8 integrated pfu) throughout.

GEO Electron Environment	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	50	60	60	70
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 6: MOSWOC REFM Electron Fluence – currently just below the threshold, but with a rising trend.



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